higher frequency components accurately. In this type of computer, when problems have a lower R than the computer does, they are generally scaled to be in the low end of the computer spectrum. This type lends itself much more readily to real time simulation, of course, being essentially ideal over the range of frequencies significant in mechanical apparatus. It is not as accurate inherently as the servo type, due to the static errors in contemporary electronic multipliers and function generators, and in pen recorders. Maximum errors in these devices run from ± 0.5% to ± 2% of full scale. However, the cost can be radically less, and the convenience probably better overall, because of the short solution times. If used as intended, even open-loop integrators will not require frequent rezeroing. If amplifiers designed for this type of computer are used with servo-type computers on problems involving very long solution times, they obviously should not be used as integrators, especially open-loop ones.

No discussion of system analysis can be complete without mention of the "AC" or repetitive computer. In an AC computer, actual computation time is reduced to a few milliseconds to eliminate integrator drift. Readout is on an oscilloscope, to be consistent with the computer frequency range. This makes output easier to observe, but more difficult to record. One high frequency limitation is in the operational amplifier itself, which is generally not true for the other types. In one version, the computing period is 4 milliseconds. For a gain of 1, and ϕ = 0.01 radians, f_h = 1000 cps. R = .004 x 1000 = 4. This very small value of R has seriously compromised the value of the equipment. If it had been run with a computing time of, say, 0.1 sec., the drift would still be negligible, and R = 100, a more practical value, although still pretty tight.

Another objection to ac computers is that they cannot be used in real-time simulation.

APPENDIX

Open-loop transfer function:

$$\overset{\text{amp 1}}{\left(\frac{1}{C_1 p + \frac{A}{R_1}}\right)} \overset{\text{amp 2}}{\left(\frac{K_2}{Tp+1}\right)} \overset{\text{amp 3}}{\frac{k}{R_3 C_3 p}}$$

$$= \frac{R_1 K_2 k}{A\left[\left(\frac{R_1 C_1}{A} p + 1\right)\left(Tp+1\right) R_3 C_3 p\right]}$$

Then the closed-loop transfer function is

$$\frac{\dfrac{R_1 K_2 k}{A\left[\left(\frac{R_1 C_1}{A} p + 1\right)\left(Tp+1\right) R_3 C_3 p\right]}}{1 + \dfrac{R_1 K_2 k}{A\left[\left(\frac{R_1 C_1}{A} p + 1\right)\left(Tp+1\right) R_3 C_3 p\right]}}$$

$$= \frac{\dfrac{R_1 K_2 k}{A}}{\dfrac{T R_1 C_1 R_3 C_3}{A} p^3 + \left[\dfrac{R_1 C_1 R_3 C_3}{A} + T R_3 C_3\right] p^2 + R_3 C_3 p + \dfrac{R_1 K_2 k}{A}}$$

Note that $$T << \frac{R_1 C_1}{A}$$

If A is adjusted for constant amplitude of oscillation, the transfer function must be

$$\frac{1}{\dfrac{p^2}{\omega_{n^2}} + 1}$$

where ω_n is the frequency of oscillation in radians/sec, in which case

$$\frac{T}{\omega_{n^2}} p^3 = \frac{A}{\omega_{n^2} R_1 C_1} p.$$

Under these conditions, $p^2 = \omega_{n^2}$,

$$\text{so } T = \frac{A}{\omega_{n^2} R_1 C_1}$$

THE MODEL II UNITYPER

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SUMMARY – This paper relates some of the considerations that led the designers to develop the all-mechanical Model II Unityper, in order to achieve a smaller, less expensive input transcriber than the larger electronic first model. Operational characteristics are discussed, and the relationship of the unit to the rest of the computing system is given.

After the Univac design was finished, its builders set out to develop an input transcriber capable of converting raw input material to magnetic tape recording. This transcribing function does not present a difficult design problem in itself. However, the problems of operator error with the consequent necessity for backspacing and erasure, the necessities of monitoring operations and producing visual evidence of the material recorded, and the task of converting large amounts of data in repetitive patterns, all tend to make the design quite complex. At the time the design was undertaken, there were no data available on the requirements which might be imposed on such an input transcriber. There was only one sure indication of what form the final system must take: it must be a tape recording device, for magnetic recording had been decided upon as the only feasible input-output medium. The transcriber incorporated every possible automatic operation and control function (instead of only a limited and arbitrary selection of those which appeared to be reasonable). It was fundamentally electronic in design, and was called a Unityper. Upon being constructed, the Unityper proved the practicability of transcribing raw data directly from a keyboard onto a magnetic tape.

To accommodate both alphabetic and numerical data, this Model I Unityper uses for a layout pattern the keyboard of a typewriter. The operation of the device is cyclic in character. The striking of a key on the keyboard discharges a capacitor into a resistor matrix which sends a code combination to the channels of the magnetic recording head. The pulse from the keyboard sets a delay-flop whose output triggers a 96-pole motor from one stable state to the next. This motor operates the centerdrive, moving the tape 1/20th of an inch. When the tape has traveled and stopped, the equipment is ready to receive a new code combination.

In addition to this relatively straightforward cycle of operation, the initial design incorporated an automatic operator, which enables the typist to keep one code combination recirculating through the system for a controlled length of time. This permits the automatic execution of repetitive operations such as filling, and the automatic recording of code patterns which recur continually. A number of alarm circuits prohibit such mistakes as striking two keys at the same time, violating one of the many possible control "fields" of the automatic operator, backspacing into the space between blocks, typing too many words in any block, and other error-operations. Furthermore, each reel is separately powered by means of a 1/4-horsepower torque motor, and the 96-pole synchronous stepping motor already mentioned operates the centerdrive system. The reel motors require brakes and brake controls to ensure that the tape is kept taut in its path at all times, and yet not subjected to over-tensing.

With the limited production facilities at the disposal of the F-' rt-Mauchly organization at that time, it was natural to evolve an electronic design which could be constructed with the same assembly procedures used for the Univac itself. The Model I Unityper has been put into extensive use transcribing all types of data. Out of the experience with functioning data-processing systems has come an evaluation of the various features which was not available when the first Unityper was in the blueprint stage.

One critical factor, among others, is that an electronic device operates at speeds beyond the necessities of the human operator. The operating speed of mechanical equipment is adequate to these necessities, and the equipment itself is less expensive. The larger mechanical facilities and skills of the Remington Rand organization permitted the mass production of die-stamped and machined assemblies. It was therefore decided to explore the possibilities of a mechanical transcribing device that would use as much as possible of predesigned and standard mechanical equipment. The resulting Model II Unitype, shown in Fig. 1, is much smaller and much less costly to build, and at the same time retains all the features of Unityper I that have proven worthwhile in a keyboard-to-tape transcriber.

REQUIREMENTS

Since the typewriter keyboard presents a familiar and simple layout of the numerical and alphabetical elements of data, it was decided to investigate the feasibility of using a standard electromechanical typewriter. A little investigation disclosed some interesting parallels between the operations required of an input transcriber and the operational characteristics of a typewriter.

First there is the coding problem. For each key depressed on the transcription device, a combination of eight possible pulses must be coded up and sent to the eight channels of the recording head. Each key must produce a unique combination of these pulses.

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On most electromechanical typewriters, the movement of a key brings an associated eccentric into contact with a constant-speed power roller. The eccentric, in turning, pulls down the typebar mechanism, which flips the typebar toward the platen. Each key is associated with only one eccentric and only one typebar.

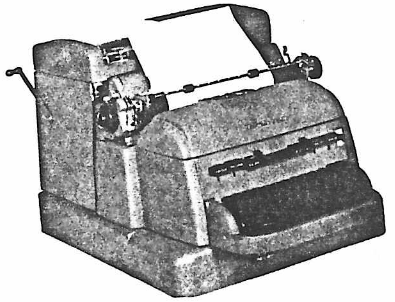

Fig. 1 – The Model II Unityper.

A mechanical system of eight bails, one for each pulse of the eight-channel code, operated by lift-arms connected to the typebar mechanism, can serve as an encoder if each bail is selectively notched according to the pulse code, and connected to a switch for passing the recording currents. This provides a magnetically reproducible code pattern, while the normal mechanism of the typewriter provides a printed record of the material typed in.

The next requirement imposed on the system is that of obtaining discrete tape movement. Because the tape must occasionally be stepped backward one space at a time, for entering corrections, etc., the tape drive must move the tape the same distance in both forward and backward operation. But this requirement is also imposed on typewriter mechanisms: the carriage escapes a discrete distance for each character typed, while backspace moves the carriage exactly the same amount in the opposite direction. The distance is mechanically fixed by the escapement mechanism. The decision here was again obvious: use the motion of the one device to generate the same order of motion in the other.

THE TYPEWRITER

The basic unit of the Unityper is a Remington Rand Electri-conomy typewriter. Its purpose in the scheme of things is to provide a familiar starting point for the encoding process, translate the single letters or digits into the multi-element code, and produce a printed copy of the material encoded. Many of the functions of the typewriter are tapped to provide for other functions required throughout the Unityper.

The standard machine has 42 keys, which connect through mechanical linkage to 42 eccentrics, each of which can activate a typebar. The action of each typebar allows the carriage to escape one letter-space; on a machine using elite type, which is the type size used on the Unityper, the carriage escapes 1/12".

Power Linkage The linkage from one key through a power arm to its eccentric and the typebar is shown in Fig. 2. The ball interlock, and the lift-arm extending down from the center, do not exist in the original typewriter mechanism. The rest of the linkage is all standard on the Electri-conomy typewriter. The heavy straight arrows on the drawing indicate direction of movement of the various members, while the curved arrows are drawn around the various pivot points.

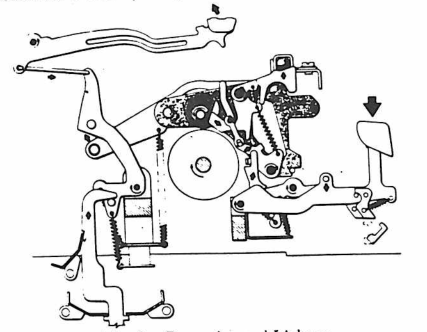

Fig. 2 – Power Arm and Linkage.

A pressure on the key works through the intermediate linkage to perform three functions: to bring an arm to bear on the nylon eccentric; to disengage the lock member from the undercut in the eccentric, and to push a blade (which pivots the lock member) into the ball interlock slot shown in the upper right portion of the drawing.

The eccentric is pushed down onto the power roller, which rotates constantly. The power roller drives the eccentric through one complete rotation. As it turns, the eccentric raises the entire power arm assembly, which pivots at one end. Mounted on the other end of the power arm is a small roller which rides against the flat surface of the actuator bell crank. When the actuator bell crank pivots, it draws the typebar pullwire to the right. Due to the arm ratio of the typebar, the short pull on the wire flips the typebar sharply toward the platen.

The intermediate linkage from the key is disengaged after one operation. The lock member rides against the eccentric until the undercut appears, then falls back into the locked position. The shape of the eccentric allows it to clear the power roller just before it is re-engaged by the lock member.

The interlock trough of forty-nine balls contains just enough space to accommodate one lock blade. A second key cannot be operated until the first eccentric returns to its normal position, due to the fact that two blades cannot enter the trough at the same time.

The actuator bell crank has been modified for Unityper II by the addition of a pin at its lower end, which engages the hooked portion of the encoder lift-arm. When the lift-arm is raised, it engages a combination of the encoder bails to set up the code.

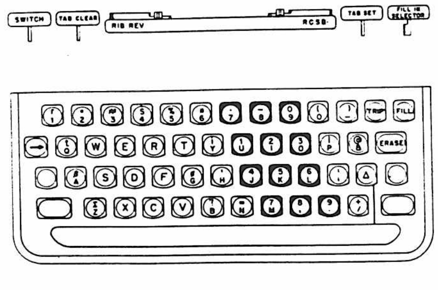

Fig. 3 - The Keyboard.

Keyboard and Modifications The keyboard is illustrated in Fig. 3. The modifications and changes from the standard keyboard include the following:

...Two keys have been added on the top bank: the numeral 1 to the left of the 2, and TRIP key at the right end.

...A keyboard of numerals has been included in the upper-case positions of part of the right hand side of the keyboard. These were added to provide a convenient keyboard for typing all-numerical data. The upper-case positions of some other letter-keys have been used for symbols of special significance to Univac.

...A failsafe solenoid-operated keyboard lock, sometimes called the line lock, has been added to prevent operation of the keyboard at all times except during the Type stage of the operating cycle.

...The standard CARRIAGE RETURN key has been replaced by a key marked ERASE. The function insofar as typewriter operation is concerned is identical, however.

...The normal TAB key is marked FILL; the function is almost the same, excepting that the FILL operation records either space symbols or zeroes on the tape according to the position of a FILL SELECTOR switch. This switch, in the position of the normal MARGIN RELEASE, enables the operator to select either space symbols or zeroes when filling in unused block space by tabbing through it. (The margin is fixed at 120 characters; there is consequently no need of a margin release on the Unityper.)

...The SPACEBAR is disconnected from the normal carriage escapement, and mechanically coupled instead to the key marked Δ in the drawing. Operation of the spacebar thus not only records the symbol meaning space on the tape, but prints a Δ on the paper. In this way the user is assured that there is a symbol on the paper for every symbol on the tape. For example, an operator cannot backspace too far and then merely space to the correct position (which normally would erase all previous data from the tape and enter the space symbol instead); she must, if she backspaces too far, re-enter all the information in its correct position. If she does not, the Δ symbol shows up on the paper overriding the previously entered data.

...All margin controls and manual carriage controls are removed, so that the number of characters in a line is fixed (at 120), and so that the carriage cannot be moved to the left except by depressing a key or the spacebar. To prevent its manual movement to the right, an additional escapement wheel has been added, which is indexed in the opposite direction from the normal escapement. This makes it necessary to use either BACKSPACE, ERASE, or TRIP key when moving the carriage to the right. It is thus impossible to move the carriage in either direction except from the keyboard.

There are four other modifications to the typewriter to accommodate the requirements for Unityper II. The mechanical ball interlock in the linkage from the keys, which prevents the striking of two keys at the same time, has already been mentioned. The lift-arms and encoding bails, mounted unter the typewriter, will be treated in detail a little later. The two additional components are a commutator with two faces, which is turned by the carriage escapement; and a power takeoff from the typewriter motor.

The power takeoff is led through a flexible cable into the tape panel behind the typewriter, where it is terminated in a rubber capstan inside an annular channel concentric with the hub of the center drive wheel. This capstan can be moved against either the inner or outer ring of the annulus, for the purpose of providing fast forward motion to load a length of leader tape at the start of a reel, or fast reverse motion for rewind. Normally, however, it spins disengaged from either ring, and the movement of the carriage operates the center drive.

These modifications permitted a design for an encoder and for a tape transport system which are driven and controlled by the typewriter action. The removal of the margin and carriage controls and the addition of the ball interlock also provide accuracy and safety guarantees.

The Encoder The encoder is the name given to the portion of the Unityper which translates the movement of a typebar into a pattern of magnetic pulses across the width of the Univac tape. Its primary purpose is one of translation: the single character identified by the key and the typebar must be translated into a unique combination of eight characters representing the digit or letter to the computer. The encoder is housed underneath the typewriter, and is completely mechanical.

The striking of a key on the typewriter acts through its eccentric, as described above, to flip the typebar and raise the lift-arm. The cutaway view of the encoder (Fig. 4) illustrates a few of the lift arms, and shows the notches which are cut into the horizontal encoding bails. All forty-four of the lift arms are the same; the eight bails are notched so that any one bail will be pulled up by the projection on the lift-arm only if the character associated with that lift-arm requires a pulse in the digit-position represented by the bail. Each of the bails operates a switch, which closes when the bail is engaged. In this way the switches set up the code for each character. They connect directly to the head through a resistive balancing circuit.

The lift-arms are held up in position by a latching bail, also illustrated in Fig. 4. The bail is so placed

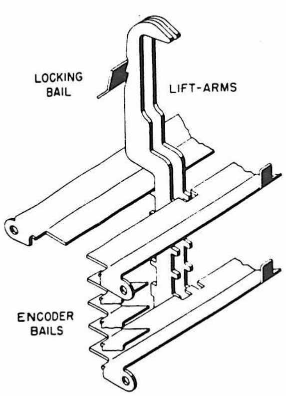

Fig. 4 – Detail of the Encoder.

that it catches against a sawtooth notch on the shaft of the lift-arm, and locks it into position after it is selected.

After the bar has pulled up a combination of bails, and the code is set up, one face of the commutator disc applies recording power through the switches to the head. The commutator is geared to the carriage escapement, and steps twenty degrees for every character.

In each twenty-degree sector of the circle are two contacts, on opposite faces of the disc. The two sets of contacts are displaced from each other by approximately ten degrees. The first of these applies the recording voltage to the head; the second connects the actuator power source to an unlatching solenoid. This solenoid, when it closes, removes the latching bail so that the lift-arm returns to its normal position after the recording takes place.

Between carriage movements, no recording power is applied through the switches. An erase voltage, however, is applied to the resistive balancing circuit at all times except during rewind, so that all channels of the recording head erase when they are not specifically set up for recording.

The shift operation is accounted for in the encoder by having the entire arrangement of bails shift to the left when the type basket is shifted. The notches cut in the bails differ in the two positions if the upper case character on the keyboard differs from the lower case. The code can be changed entirely by this means; there is no inherent necessity for an upper case character to bear any relation to the lower case character on the same key.

During BACKSPACE, all power is removed from the head by a switch, so that neither recording nor erasing occur while the carriage is being stepped backwards. The switch operated by the backspace actuator solenoid opens the ground return from the head. It was included to accommodate the overshoot of the carriage when it is being stepped backwards. The erroneous information on the tape is erased as the corrected version is entered.

THE TAPE PANEL

The remaining functions of the Unityper are merely those of a tape transport device which operates synchronously with the typewriter. The tape panel, which contains the components necessary to fulfill these functions, is mounted behind the typewriter. In a space the height and width of the typewriter and approximately eight inches deep are enclosed the takeup reel, the supply reel mount, the erasing and recording heads, and the apparatus which controls the operating cycle of the Unityper.

The tape panel is substantially a mechanical device. There are no motors or vacuum tubes in it, and what motive power is required is furnished manually (as in the case of pulling the operating lever), or applied from the typewriter. Of the switches in the tape panel, all but one are mechanically operated.

Centerdrive The centerdrive mechanism is powered by the typewriter itself. Mounted on a standoff which is

bolted to the carriage is a double clamp (illustrated in Fig. 5), which has two engaged positions and one neutral. Through each of the two clamp positions runs one loop of a belt which wraps around the centerdrive wheel under

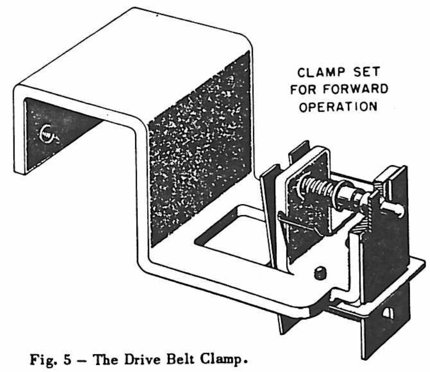

Fig. 5 – The Drive Belt Clamp.

the motorboard of the tape panel. For motion of the carriage in a given direction, one loop turns the centerdrive wheel in a direction opposite to the other. The threading of the drive belt is illustrated in Fig. 6.

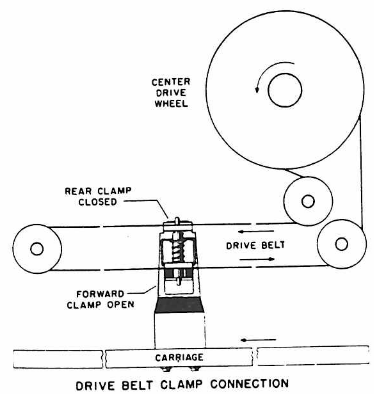

Fig. 6 – Drive Belt Clamp Connection.

The clamp is spring-loaded in such a fashion that it tends to grasp the forward of the two loops. It is normally set, however, so that it clutches the rearward of the two. In this state, motion of the carriage to the left (normal typing) moves the centerdrive counterclockwise, which feeds tape in a forward direction through the system and past the recording head. At the end of a correct line, the carriage must be returned to the right, but the tape must continue to feed forward. The TRIP key, added on the right end of the top bank of keys, operates the carriage return mechanism through an actuator; at the same time the TRIP key sends power to another solenoid which trips the drive clamp and jams it into its stable state, clutching the forward loop of the belt. This reverses the relation between the carriage and the tape drive so that tape continues to feed forward while the carriage is returning.

At the end of an incorrect line, or at any point where the operator desires to erase the whole line of type from the tape, the ERASE key may be depressed. This merely returns the carriage; since the tape drive clamp is not tripped, the tape feeds backward too, and so is erased. The same case holds true for BACKSPACE, excepting that the head circuit is opened, and the single character is not erased until the next recorded character overrides it.

In the neutral state, which can be entered into only while the carriage is in the first-digit position, a cam holds the drive clamp in the middle of its travel, so that neither the forward nor the rearward clamp is engaged, and the drive belt passes freely through. This position is used during rewind, and while the device is loading the necessary length of leader tape at the beginning of a reel. During these operations, the centerdrive wheel is rotated directly by means of the power take-off from the typewriter motor.

The ratio of the diameters of the centerdrive wheel underneath the motorboard, and the centerdrive capstan above the motor-board, is such that for each ten inches of travel of the carriage, which causes ten inches peripheral displacement of the centerdrive wheel, the centerdrive capstan transports two and four-tenths inches of tape past the recording head. Since the pitch of the type is twelve to the inch, the density of recording on tape is fifty characters to the inch.

The 10:2.4 ratio is further useful in providing for the space required to give the Uniservo time to stop and start between blocks. The input synchronizer in the computer can accept only 720 characters at a time; all information read into the computer by the Uniservo therefore must be in 720-digit blocks. Between these blocks must occur a sufficient space for the Uniservo to start and stop.

The carriage is fixed on the Unityper so that only 120 characters will be accepted as a line. Less than this amount will not permit the TRIP operation to take place; more than this amount cannot be accepted by the typewriter since the margin and keyboard are locked and will not release. As the carriage is returned after each line, the ten-inch travel of the carriage causes the tape to be moved 2.4". These spaces contain no information, and are normally passed over and ignored by the Uniservo. However, after the sixth line, the counter in the input circuits of the central computer has reached 720. A signal is sent to the Uniservo to indicate that the block is

completed and that the input register is full. The Uniservo then coasts to a halt in the sixth space, which assumes the significance of a space between blocks.

The writing head used on Unityper is the standard eight-channel electromagnetic head used throughout the Univac System. A special permanent-magnet erasing head is mounted in the tape path just in advance of the recording head, so that the tape is erased before it is passed through the recording fields. This head is automatically removed from its position against the tape during the Rewind process.

Reel Control The two reels are the same size. Any constant rotation of either reel causes a non-linear feed of tape, due to the fact that the very act of feeding tape from one reel to the other increases the effective diameter of one reel, and decreases that of the other.

In the design of Unityper I, both reels were powered separately, and the size of the free tape path was sensed to determine which of the two reels had to be unbraked to keep the proper amount of tape in the path. However, the design of the Model II Unityper aimed to simplify this process. The requisite motive power already exists in that the movement of the tape can move the reels if they are properly mounted. The problems are to accommodate the differences in the relative diameters of the reels, and to include a mechanical low-pass filter between the reels and the centerdrive such that the high-inertia reels need not respond to the large accelerations experienced by the centerdrive capstan.

The solution to the latter problem involved mounting two of the pulleys around which the tape passes in a very light floating frame, so that discrete elements of movement are absorbed. The intermittent motion of the centerdrive capstan is consequently smoothed out, and a slower response to a larger integrated motion is all that is expected of the reels. To solve the differential problem, both reels were mounted on the same axis, but not on the same axle. The supply reel mount is above the motor-board of the tape panel for easy accessibility; its shaft, which forms the axis of the entire reel assembly, projects down through the motorboard to terminate in a buttplate at the bottom of the assembly. The takeup reel, which is not removable, is below the motorboard. It is fixed, at a point about half-way from its center, to a differential spring of the clock mainspring variety. An exploded view of the reel assembly is given in Fig. 7.

The inner diameter of the clockspring is permanently attached to a drum which surrounds the supply reel shaft without touching it. Contact between the drum and the shaft is obtained through a spring clutch, fixed at its lower end to the shaft buttplate, and wound around the takeup reel drum.

An equilibrium is established between the differential spring tension and the tensions in the tape path. When the centerdrive wheel turns, and tape is pulled out from the supply reel, the resulting imbalance permits the differential spring, inside the takeup reel, to operate to turn the takeup reel. The centerdrive, in other words, supplies the force that pulls both reels. The differential spring merely absorbs the differential moment resulting from the difference in working diameters of the two

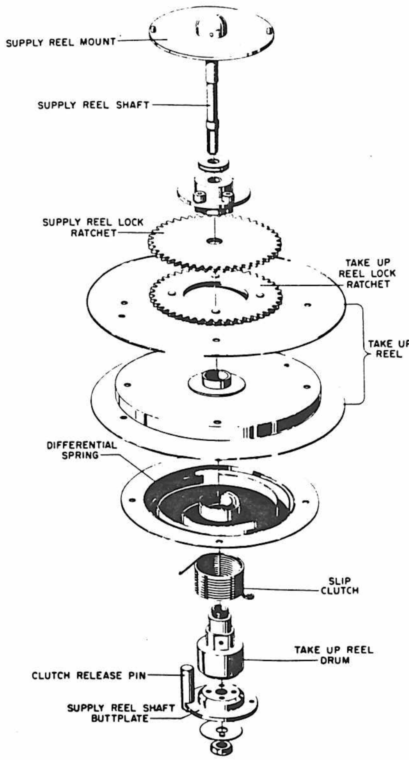

Fig. 7 – Exploded View, Reel Assembly.

reels. Since the force of the clockspring is proportional to its compression, and since it is fully wound to start with, the takeup reel is subject to a greater force when it is empty than at any other time. It consequently tends to accelerate more rapidly at the beginning of a tape run than subsequently. However, its applied tension decreases as it unwinds. When the supply reel is half empty, the takeup reel is half full; from this point until the supply reel is completely empty, the same linear travel of tape will tend to move the supply reel more than the takeup reel. The supply reel, of course, can move freely as the tape pulls it. The takeup reel can move no farther than the free tape will permit. Since it cannot turn

as far as the supply reel turns, there is again a differential moment. This is absorbed by the clockspring, which becomes wound. When the supply reel has been completely emptied, the clockspring is rewound to its original compression.

The rotary motion of the supply reel shaft is transmitted through a helical coil clutch spring wound around the takeup reel drum. This coil is fixed at its lower end to the buttplate at the base of the shaft. Its upper end is brought out about half an inch on a tangent to the normal circumference. A detail of this clutch spring, the drum, the axle, and the differential clockspring, as they appear when assembled, is given in Fig. 8.

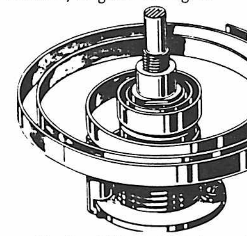

Fig. 8 – Differential Spring and Clutch.

The inner diameter of the clutch spring and the outer diameter of the takeup reel drum are the same when the clutch is not under stress. When the supply reel shaft turns, the clutch spring is turned too. It compresses around the drum and turns it, allowing the takeup reel to turn, and winding the clockspring.

When the potential force built up in the clockspring is equal to the force inherent in the coil, the coil wraps around the drum so tightly that the lower windings are forced into the undercut at the base of the drum. The tightening of the coil decreases the inner diameter, and permits the lower windings to turn with respect to the upper windings. The projecting end moves into contact with a pin fixed to the buttplate, also shown in Figs. 7 and 8. The pin opens the coil, allowing the drum and the shaft to turn free of each other. This prevents any accidental overwinding of the clockspring, which might break the spring.

Since the tape is in equilibrium between the force of the clockspring and the tensions of the free tape path, overwinding of the spring might also strain the tape and decrease its life. However, this safety feature is not required during normal operation, since the spring can only wind as much as it was unwound. The only time the clutch will open in this manner is when the clockspring is initially wound up. The initial winding is done by turning the supply reel mount by hand with no tape in the tape path. The supply reel will turn, winding the clockspring, until the clutch slips. After that any further turning of the reel will result in the clutch's slipping without either winding the spring or doing any harm to the system.

THE OPERATING CYCLE

The controls of the operating cycle of Unityper II, like the rest of the system, are mostly mechanical. An operating lever on the left side of the tape panel operates an arrangement of cams and bell cranks to institute a regular cycle of Load Tape, Load Leader, Type and Rewind. The Load Tape and Type positions are automatically entered into, following Rewind and Load Leader respectively. Operator's decisions control the points at which Rewind and Load Leader are brought about; the two operations can be initiated only under certain fixed conditions, however.

Part of this same operating control mechanism is for the purpose of providing certain safety interlocks. Other parts open or close the recording voltage circuit and the keyboard lock actuator circuit. One cam is for the purpose of holding the tape drive clamp in its neutral (unstable) state, so that both loops of the drive belt can pass freely through the clamp during Load Leader and Rewind. Another bell crank positions the power takeoff inside the annular channel of the centerdrive wheel, so that during these two stages of the cycle the wheel moves rapidly counterclockwise or clockwise without any carriage movement.

Other control components in the tape panel:

1. Provide automatic locks to lock the door from the time operation starts on any tape until that tape is rewound;
2. Latch the two reels in fixed position when the door is opened, and lift the latches off only when the operating lever is next pulled;
3. Lift off the pawl which normally couples the operating lever to the control ratchet whenever the machine is busy with some function, so that the mechanism is not permitted to try to do two things at a time;
4. Provide a method of stopping the rapid-action stages of the operating cycle, Load Leader and Rewind, without operator interference.

When the operator has loaded a blank reel of tape on the supply reel mount, she shuts the door and pulls the operating lever (the operating lever will not function unless the door is shut). The Unityper automatically loads fifteen feet of tape onto the takeup reel; in the meantime, a stop nut is fixed laterally so that it rides up a screw, stopping the load action when it reaches the top of its travel. The machine is then ready for typing. A cam-operated switch automatically activates a solenoid to release the keyboard lock at this time. The keyboard lock, or line lock, is released only during the Type stage of the operating cycle.

The operator proceeds to type. If she makes a single error, she operates the backspace to correct it; this not only returns the carriage one digit-space, but backs the tape up a corresponding amount. While the tape is back-

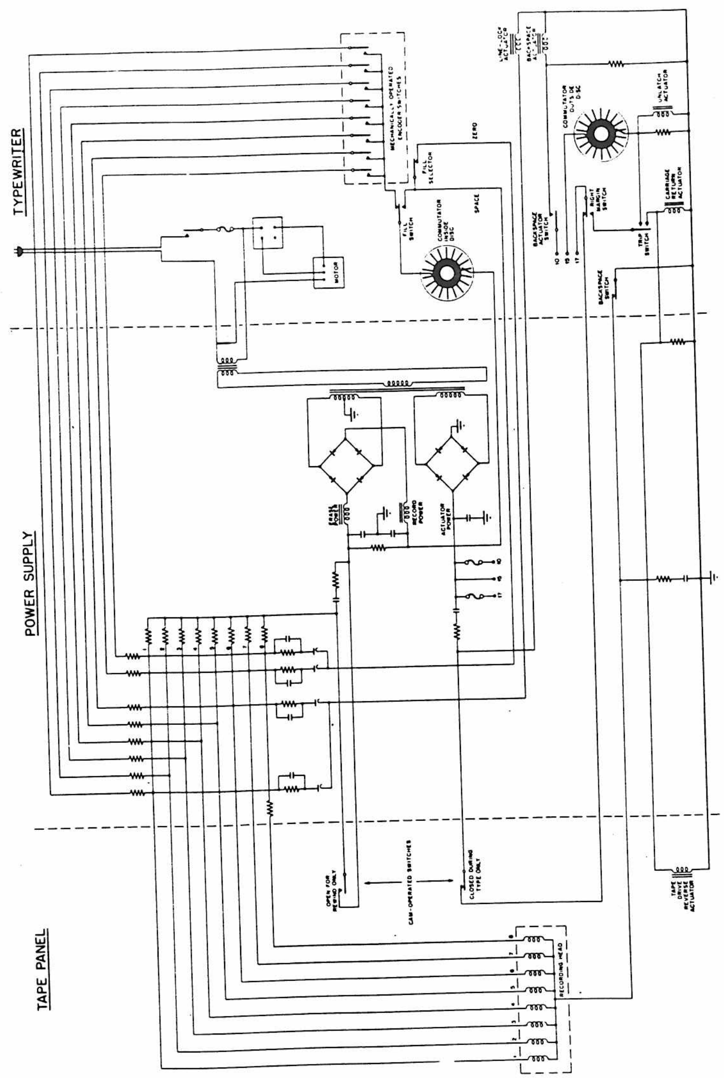

Fig. 9 – Schematic Diagram, Unityper II.

ing up, a switch opens the ground return circuit from the head coils, so that neither erasing nor recording can be done over the incorrect area. When she reenters the correct version, the incorrect digit or digits will naturally be erased.

If she makes more than one error, she may want to erase the whole line. The ERASE key is identical with the normal carriage return; the carriage is drawn back to its left limit, the tape travels with it, and the entire line of data is erased as it passes over the head.

If the TRIP key is struck at any time except when the carriage is at the right margin, it will print an underscore without moving either carriage or tape, and without recording anything on the tape. When the 120th digit has been entered in any line, however, and the carriage moves into the 121st digit-position, the right margin switch closes. Depressing the TRIP switch at this point will apply power to two actuators: one to operate the carriage return mechanism, and the other to reverse the tape drive so that tape will be fed forward while the carriage travels backward. The unlatch actuator also receives power, so that the encoder will be cleared to start the new line. The tape drive clamp is reset as the carriage approaches its left limit.

In each 1st-digit position, the handle pawl on the operating lever drops onto the control ratchet, so that the operator may initiate a rewind after typing any complete line. The operating lever is disabled by the raising of the pawl immediately after the first digit is entered, since rewind is never required excepting at the end of a line of information.

Rewind, when initiated by the operator, stops automatically as the last loop of tape unwraps from around the takeup reel. A spring leaf which is held by the tape against the hub of the takeup reel springs out and trips a pawl on the control mechanism, which indexes into a neutral position and stops the rewind.

THE POWER SUPPLY

The power supply for the Model II Unityper consists of two selenium bridge rectifiers, one of which is grounded at its center. This bridge produces equal positive and negative voltages, the former for erasing and the latter for recording. The second bridge provides actuator power for the various control solenoids in the machine.

The positive and negative voltages are applied to the head through a resistive balancing circuit, also located in the power unit. Because the recording voltage is applied through a commutator, the duty-cycle of the recording operation is mechanically determined. The erasing voltage, on the other hand, is applied at all times excepting during backspace and rewind. The two cam-operated switches which open the erasing voltage circuit during rewind and close the circuit to the keyboard lock release for typing are located in the tape panel, and are operated by cams on the control shaft of the operating lever.

The power consumption of the Model II Unityper is 75 watts, including the power consumed by the 1/28-hp motor of the typewriter itself.

The complete electrical schematic of the Unityper is given in Fig. 9. Although it covers only a small amount of space, this schematic describes a complete unit which adequately fulfills the input requirements of the Univac System.

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